Macmillan talks to Khrushchev. Eisenhower talks to DeGaulle. Can the nations' representatives be better trained for such vital meetings? Just as "generals" compete in simulated war games, can "chiefs of state" and "foreign ministers" learn their skills from similar games among nations? Alliances, international parleys, governmental conferences, and internal decisions all are part of the simulation techniques suggested below. Exciting possibilities for the development of international relations theory and training are in the offing.

A USE OF SIMULATION IN THE STUDY OF INTER-NATION RELATIONS

by Harold Guetzkow

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EVENTS, as recorded in all their variety in historical and contemporary documents, are the usual basis for the development of theory about relations among nations. These international events our theory must explain, and these events we eventually hope to predict. Such theory building—consisting of the development of adequate concepts and the relations of these concepts to each other in propositions—must encompass the welter of facts from life situations. Our theories of international relations—be they implicit or explicit—are the stuff from which we compose our policies, and write our newspapers and textbooks. This essay describes an initial effort to utilize simulation techniques as complementary means both for the development of theory and for instructional purposes.[1]

Simulation is an operating representation of central features of reality. Simulations may take the form of war games, of pilot chemical plants, of ship-and-harbor scale models, of computer-inventory systems. There are a multitude of such representations (Malcolm, 1958). Will a social simulation of inter-nation relations prove to be of value as a heuristic device for theory development in international relations research? May inter-nation simulation be arranged to allow live participants to play component units for training purposes? Three exploratory runs of an inter-nation simulation in the laboratory of the Program of Graduate Training and Research in International Relations at Northwestern University in 1957–58 suggest that simulation technique may be useful for purposes of both research and training.

BACKGROUND FOR SIMULATION

The efforts in simulation at Northwestern were stimulated by two streams of intellectual endeavor, one represented in the war game and the other deriving from the social psychological group experiment.

The war game has been in existence for many centuries. During the 19th century it flowered in the "rigid" game, in which complicated problems were played by military decision-makers with outcomes determined by elaborate rule books. During the latter part of the 19th century, the "free" game was reinstated, in which the game "director," a battle-experienced military officer, determined the outcomes of plays on the basis of his judgment. Participants in World War I and II employed the war game as a training device—and in World War II, the device was used extensively as a quasi-research tool, for prediction of the outcome of military efforts, such as the Battle of Midway and the invasion of the Ukraine. After World War II the development of the war game continued, returning to more rigid forms with the cumbersome rule book being replaced by the lightning-swift programmed computer. From the point of view of the student of international relations, the flowering of a RAND Corporation effort—the military-political game, COLD WAR, as developed by its Division of Mathematics and the POLITICAL EXERCISE, as initiated by Goldhamer and developed in its Division of Social Science (Goldsen, 1956)—is most useful.[2]

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[1] Early plans for the simulation were thought through during my stay at the Center for Advanced Study in the Behavioral Sciences. The three exploratory runs reported in this paper were supported in 1957–58 by funds from the Carnegie Corporation of New York. My colleagues and students at Northwestern made many suggestions during the seminars devoted to the formulation of these runs. Professors Richard C. Snyder, George I. Blanksten, and R. Barry Farrell personally participated in the early trial run. Mr. Denis A. Sullivan shared some of the preliminary results from his inventory of propositions in international relations, which further helped guide my selection of key variables. But above all, full credit must go to Mr. Robert C. Noel for developing the mechanics of the simulation in a most creative way, never allowing theoretical objectives to be swamped by practical necessities.

The immediate impetus for explorations in simulation came from the author's work in the social psychology of groups. Since the 1930s, experimental psychologists and sociologists have developed face-to-face groups in laboratories to test theories of group interaction (Cartwright and Zander, 1953; Hare, Borgatta, & Bales, 1955). This work with contrived face-to-face groups has been elaborated in the laboratory study of organizations with component parts at both the Graduate School of Industrial Administration at Carnegie Institute of Technology (Guetzkow and Bowes, 1957) and at Case Institute of Technology. An inter-nation simulation may be thought of as another step in the construction of social systems, the contriving of an inter-organizational system.

But the deeper source for this work is found in the developments in decision-making, as exemplified in the work of Simon and Snyder. Simon and his colleagues developed their interests in decision-making from the perspective of public and, later, private administration (Simon, Smithburg, & Thompson, 1950; March, & Simon, with Guetzkow, 1958). Snyder and his colleagues developed their ideas from the perspective of decision-making in foreign politics (Snyder, Bruck, & Sapin, 1954; Snyder, 1958).

DESCRIPTION OF THE INTER-NATION SIMULATION

Contrived face-to-face groups, even when they are created in the experimenter's laboratory, are more replications of reality than they are simulations. The component units—that is, the persons participating in the experiment—necessarily respond to their social environment as human beings even though the environment may be artificially simplified. In the war game, however, there is more role-playing, in which the actors need to imagine many features of the military situation and respond to each other's moves in terms of these self-imposed role conceptions. Usually there is time compression, so that, for example, a month's warfare may be enacted within a day. The mechanical and civil engineer often builds his simulation by reducing his phenomena in scale. The operations research analyst represents the flow of traffic in symbolic form, so that he may use digits in a computer as simulation of a distribution of vehicles. In making such an analogue, there often is simplification, as when traffic is allowed only to turn left or right, even though vehicles in reality can make U-turns. All these devices have been used in developing the inter-nation simulation. We have attempted to represent social units—nations, in this case—in their inter-relations with each other. We have simplified and reduced the number of variables involved. We have used both analogies and replication in contriving the parts. *Our simulation is an operating representation in reduced and/or simplified form of relations among social units by means of symbolic and/or replicate component parts.*

When one builds literary and mathematical models, one makes choices as to which features of a system are to be represented (Guetzkow, 1958a). When building social simulations, such choices also must be made. One is forced to specify units and interrelations which often may be left abstract and general in verbal models. The concreteness to be embodied in this description of the inter-nation simulation must not be taken seriously. As the work proceeds, revisions necessarily will make the representation more adequate. Eventually, variations will be introduced in order to check effects of different forms of the simulation. The choice of variables and the representation of their interlocking is highly tentative.

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[2] We are most grateful to RAND personnel for the many courtesies extended during our visits to Santa Monica and Washington. Drs. John Kennedy, Robert Chapman, Olaf Helmer, Lloyd Shapley, and Milton Weiner shared their experience in developing the COLD WAR game; Drs. Hans Speier and Joseph Goldsen allowed us many hours for discussion of their POLITICAL EXERCISE.

Five nations and their two decision-makers

In the three initial, exploratory runs described in this paper, five "nations" were operated simultaneously. During the first run, the nations were manned by one, or two, or three decision-makers. Those three units operated by one participant tended to be outward oriented, with less attention given to internal considerations. The nation which was operated by three decision-makers became quite bogged down in its internal processes, so that it had little time left for inter-state interactions. The unit manned by two decision-makers seemed balanced in its orientations. In the second and third runs, each nation was manned by two participants, senior and graduate students concentrating in political science.

In each unit, then, an "internal decision-maker" (IDM) made the nation's final decisions with regard to overall policies of the nation as they related to both external and internal considerations. Another participant served as "external decision-maker" (EDM), conducting the relations of his unit with other nations. The EDM reported to the IDM and might have been replaced by the latter. Yet, some IDMs used their EDMs as collaborators in their decisions. The two positions attempt to represent decision-making as it encompasses the nation as a whole, especially as the government relates to its resources and society, and as the nation relates to an external environment, consisting of other nations.

Office-holding

Considerable effort was made to embed the external decisions in the internal environment. The decision makers were under pressure to maintain themselves in office. Office holding depended upon the extent to which the expectations of the nation's validators (e.g., citizens, elites, juntas, and other forces which maintain decision-makers in office) were met. The probability of being maintained in office depended upon calculations made by the researchers as to how well both external and internal goals were being achieved by the nation in question. At the end of three periods of decision-making, the retention or loss of office was ascertained in each nation on the basis of random determinations (with the probability set as the average of the probabilities obtained for each period). By averaging probabilities, the decision-makers were able to take long-range points of view in making decisions which might decrease their momentary chances for office holding. Such a situation typically oc-

Two-member Teams of Four Competing Nations at Work, with Dr. Guetzkow and Mr. Noel Observing.

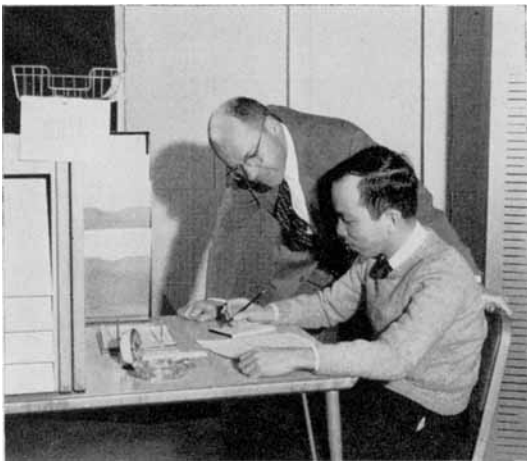
curs in electoral processes in which there is delayed response to official actions. When the probability of office holding, however, decreased to specified critical levels, an immediate determination was calculated, even though the routine determination was still some periods off. Such consequences simulated revolutions and coup d'etats.

Nation-goals

In the experiment each nation attempted to accomplish its goals, which then served as a basis for its decisions. In two of the runs, the goals were formulated by the decision-makers themselves; in the third simulation, goals were assigned to the IDMs by the researchers. Goals included objectives such as security, domination, cooperation, and internal growth.

Resource decisions

Each nation periodically received basic resources which it could allocate to its internal functioning or utilize in external affairs, either as aid or as stragetic strength. Its internal use of these resources could be distributed to its validators for immediate gratification or for building up of basic resources during the coming periods. These decisions were recorded on a decision-form by the IDMs, so that they might serve as one of the bases for computation of the probability of office-holding.



Dr. Guetzkow Conferring with the External Decision-Maker of a Nation.

Interaction among nations

Once each nation had its preliminary goals and had learned how to make its decisions with regard to its resources, the simulation was put into operation. Besides bi-lateral interaction, the EDMs arranged for conferences of some or all of the nations, with and without their IDMs. The EDMs made treaties, giving aid with or without restrictions. The strategic strength of the nation was used for various purposes, including intimidation of other nations. It was possible for one nation to declare war upon another, alone or within alliances. Some nations endeavoured to build permanent forms of international cooperation. As the interaction developed, the nations were allowed to reformulate their goals.

In the first exploratory run, there were direct communications among the EDMs in bi-lateral contacts and at conferences. However, to insure perspective on the total scene by the decision-makers, it was useful to create a communication system beyond the one established by the EDMs. During the second and third runs, an external communications system was devised by the researchers in which events were reported to all nations, so that there was more understanding by the decision-makers of what was happening within the interaction system. In this "world newspaper" reports were made by the researchers on the office losses as they occurred, how aid was extended, how treaties and alliances were developed. In addition,

An Inter-Nation Round-Table Conference.

the EDMs were permitted to publish communiques and announcements for propaganda purposes.

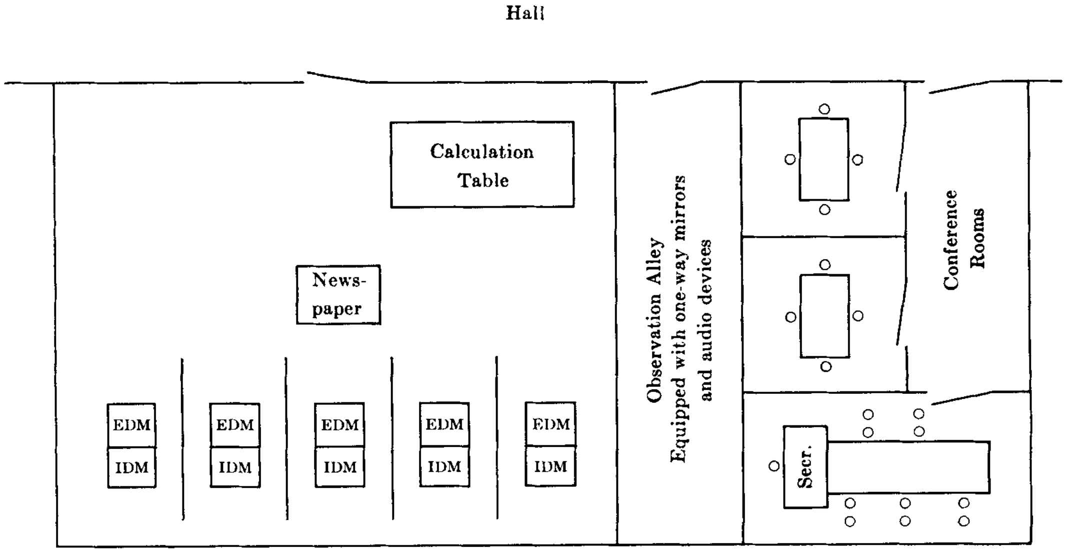
Laboratory mechanics

The group laboratory of Northwestern's Departments of Psychology and Sociology was used for the experiment, as pictured in Figure 1. Although all the participants were physically proximate, only written communications were permitted, to allow the researchers to obtain a complete record of the transactions. Within a nation, the IDM and EDM passed messages back and forth by sliding them through the barrier separating the two halves of the table at which they were seated. Non-participating messengers carried the inter-nation messages from one EDM to another. Carbons of all messages were given to the researcher-reporter, so that reports for the newspaper could be prepared from those not marked "RESTRICTED." The nations were shielded from each other by screens (but not shown in Picture 1 for photographic reasons).

The conferences were conducted at round tables, with various methods of recording. In small conferences, the decision-makers simply passed a sheet of paper back and forth, with all reading the last reply before the next response was begun. In larger conferences, a blackboard in view of all was used for the interchanges. A record was made of the messages immediately, so that each EDM might have a copy of the conference transcript.

An hour was allowed for each period of the simulation. Half-way through the period, the IDMs completed the decision-forms, so that the researchers might use them in calculating the probabilities of office holding. The consequences of their decisions were returned to the decision-makers at the beginning of the following period.

In calculating the outcomes, the researchers used a combination of rigid rules and subjective judgments. For example, the strength of states was mechanically determined from their strategic strength allocations, as combined through their alliances. On the other hand, subjective judgments were made by the simulation director as to how well the nation was achieving its evolving goals. These various measures were then



Participants' Tables
EDM and IDM separated by barrier.
Tables separated by floor screens.

FIG. 1. Group Laboratory, Northwestern University

combined into a single validator satisfaction measure, in terms of which office holding was determined mathematically.

No attempt is made in this description to give all the details of the simulation in its full concreteness. Only when the design of the simulation settles into more permanent form will it be useful to report with such elaboration. It is hoped that the above description enables the reader to picture the operations. Once we begin using the simulation for particular training or research purposes, it will be necessary, of course, to specify the details. The three runs, each lasting from three to four hours, indicate there is some hope of simulating inter-nation relations in the laboratory.

SIMULATION AS MODEL BUILDING

It is believed that inter-nation simulation will be of heuristic value in clarifying our theories of international relations. Although it is but one of alternative ways of building models about the operation of social systems, its operating character demands a greater clarity in formulation than is often necessitated in literary and mathematical formulations.

To construct an operable representation, one must specify variables with some precision and then interlock the variables with some exactitude. So that the participants and researchers can operate the model at a scale reduced from that of the original being simulated, a limited number of key variables must be selected. One attempts to represent a whole class of variables, such as the economic, by a more limited set of prototypic ones. To provide feedback from the decisions to the decision-makers, one simply must specify the interlocking which exists among the variables—otherwise there will be no inter-relation.

As in models which present verbal structures isomorphic to the phenomena being studied, one often has characteristics hidden within the interstices of the model. Because we are using human beings as decision-makers, they bring both their personal characteristics into the model and their own implicit theories of the way in which nations should behave. Eventually it will be necessary to appraise these personal styles of decision-making and organizational presuppositions, so that their influence on the evolving inter-nation interaction may be studied. In one of our exploratory runs, the presence of a decision-maker with a particularly strong interest in dominating other nations was as determinate as the presence, in another run, of a decision-maker who wanted to implement morality standards through development of an international organization.

Perhaps the heuristic values of simulation may be increased by underspecifying parts of the model. To date our strategy has been to build a well structured base for the decisions made within each nation, but to leave the structuring of inter-nation relations ambiguous. Then the interaction generated in the simulation may evolve characteristics of an inter-nation system which are quite independent of the conscious expectations of both the participants and the researchers. It was interesting to note in one run how the demands of the simulated operation forced the development of a clearer division of labor between IDM and EDM than either wanted. Will the development of the inter-nation system force supra-state organization, above and beyond the nations themselves, when we allow the simulation to continue for ten to fifteen hours instead of cutting it short at three or four?

It would be feasible to put the calculation of the decision consequences on computers, as is done in the business game of the American Management Association (Ricciardi and Craft, 1957). Should the translation of the decisions into office holding probabilities be made more complicated, it may be necessary to do this. Oliver Benson has developed an all-computer simulation called "A Simple Diplomatic Game" (1958). Using an IBM 650 Stored Program Computer, Benson is developing a generalized game involving four preparatory sets of input data, "national power," "interest in other states," the propensity of each of nine powers to act, and geographic location. Nine action decisions may then be fed into the machine, which is programmed to compute a set of consequences, as well as "counter-actions." Our simulation differs from both the AMA Business Game and Benson's Diplomatic Game in that our development allows the participants to create consequences as they derive from their inter-group interaction, quite free of programs in the computer.

One of the puzzles encountered in using simulation involving human decision-makers is the extent to which the representation shades into the phenomenon itself. In experimental work with small groups, the social psychologist actually produces face-to-face relations. One would expect in such laboratory replication of the phenomena a surer prediction to the world of nature than when one depends upon the formal isomorphism employed in a simulation. Yet, by using human components—by contriving nations as units which actually interact—to what extent has this simulation become an exemplification of the phenomena themselves? But no matter, for when models developed in simulation predict important features of real inter-nation systems, the distinction becomes of little consequence.

Perhaps most exciting is the potential which simulation models hold for exploration of contemporary verbal theories about international relations. It is feasible to simulate such characteristics as variation in size of nation, representing small and great powers in the same interaction system. It is possible to so structure the simulation as to have nations with rapid growth and slow growth in interaction with each other. We have an impressive literature which can provide hypotheses for examination within the inter-nation simulation.

For instance, we might study the proposition by Haas and Whiting that although "the majority of alliances are concluded for purposes of self-preservation, the dynamics of international relations often transform them into pacts of self-extension for at least one of the parties" (1956, p. 162). By examining the messages of the EDMs, we may understand the arguments used in persuading other nations to join alliances. Then, once established, we can check the extent to which the alliance now is used for self-extension. Consider Kennan's hypothesis, that international "conflicts are to be effectively isolated and composed" the more accurate the perception of the given power relationships surrounding the conflict (1954, p. 36). By asking our decision-makers to record their perceptions of power among the units, we can check whether accuracy in such perceptions does lead to more adequate conflict management in the simulation. Because of the costly nature of simulation, it will be wise to explore a number of related hypotheses simultaneously. For example, while one is working Kennan's hypothesis, it would be feasible, by varying the number of nations, to check Kaplan's notion that "mistakes or failure in information can be tolerated more easily if the number of actors is greater" (1957, p. 34).

Gradually tighter bodies of verbal theory are being developed. One might use simulation for exploring these verbal constructions. For example, the theory of political integration created by Van Wagenen and Deutsch and their colleagues at the Center for Research on World Political Institutions might be mirrored in simulation. Would their prediction of a pluralistic security-community among the nations be realized when conditions of mutual responsiveness to each other's needs are simulated? (Deutsch, et al., 1957, p. 66). Or explore Guetzkow's hypothesis that "the more adequately the members of a group envision the techniques of intergroup collaboration as means to their ends, the greater the tendency to move toward collaboration." (1957, p. 54). It would seem feasible to explore Kaplan's constructs of state systems, such as the hierarchical system, even though no exemplification of this phase exists at present in nature. Benson has utilized Quincy Wright's "propensity-to-act" notions in his all-computer simulation.

Once we settle upon a particular design for the inter-nation simulation, it will be feasible to represent the assembly of existent nations. First, one would need to characterize each of these nations on the present variables which are incorporated into the simulation. Using these characterizations as initial conditions, the simulation might be operated, generating consequences—that is, predictions of the evolution of the present international system.

It would seem, however, undesirable—in the present stage of underdevelopment of simulation—to attempt to have our participants role-play particular countries, such as

Spain and Indonesia. Would not such encouragement toward role-playing tend to secure reactions in terms of the presuppositions each participant has as to the nature of a particular country's reactions in a foreign policy situation? Then, as was done in the RAND exercise, we would be embodying our participant's theories of how nations are supposed to react rather than exploring reactions produced by the interaction itself.

USE OF SIMULATION FOR TRAINING

An inter-nation simulation may prove useful for training purposes in a number of situations (Guetzkow, 1958b). It may be used as exercise material in the training of policy-makers, and it may complement texts and lectures in the teaching of international relations to undergraduate and graduate students.

As the war game has been judged of practical value in providing decision-maker experience to military executives, so the manning of an inter-nation simulation may be helpful in the training of foreign policy makers. The business decision-game, developed by the American Management Association, is found useful for certain levels of management training, especially as it allows specialized executives to gain over-all perspectives.[3] It was just in this respect that the RAND political exercise was thought to have been most fruitful. Goldsen reports, "The game puts a premium on the mobilization and reordering of preexisting knowledge in relation to a special focus, a focus on political action, policy thinking. . . and the analytic assessments of the consequences of alternative courses of action. Seeing new inter-connections of earlier insights. . . seems to have been considerably fostered by the game . . . " (1956, p. 36). The inter-nation simulation, used in conjunction with substantive training in foreign policy, could provide quasi-practical experiences in the exercise of policy judgment. By making explicit that which is often implicit, the simulation would encourage the use of more sophisticated decision-making procedures. Because the simulation could be arranged to provide a constant bombardment of decision-events, practice in decision-making under continuous pressure might be obtained from its use by policy officers preparing for heavy interaction situations. Perhaps the inter-nation simulation can be developed as an adjunct to the case materials being used in the career development programs for foreign service officers in our Foreign Service Institute.

Undergraduate senior students were involved along with graduate students in the three initial exploratory runs reported herein. Seniors with an international relations course background seemed to profit from the experience more than those without. They felt they were actually making use of their knowledge, as they came face-to-face with the quasi-realities of foreign policy decisions. This opportunity to behave as responsible decision-makers increased their enthusiasms for further understanding of the nature of international politics. They felt they were plumbing the depth and extent of their knowledge. One of the students reported, "The simulation really brought me down to earth. I finally faced the complexities of international relations. All nations wanted their own ways and it's hard to accomplish what you want." The simulation might be integrated as a series of laboratory exercises in international relations. As Alger suggests for an international organization course, the simulation might be designed to demonstrate progressive stages of international structure, going from bi-lateral relations to international conferences, to intermittent councils, to continuous session international bodies without and with secretariates (Alger).

The graduate students found their experiences in the simulation rewarding in many of the same ways as the undergraduates. But in addition, they were most intrigued with its potential as a research tool for building explicit theory.

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> It would be no use for beauty to fake up a few numerical attributes (expressing for instance the ideal proportions of symmetry) in the hope of thereby gaining admission into the portals of science and carrying on an aesthetic crusade within. It would find that the numerical aspects were duly admitted, but the aesthetic significance of them left outside. So also entropy is admitted in its numerical aspect; if it has as we faintly suspect some deeper significance touching that which appears in our consciousness as *purpose* (opposed to *chance*), that significance is left outside. These fare no worse than mass, distance, and the like which surely must have some significance beyond mere numbers; if so, that significance is lost on their incorporation into the scientific scheme—the world of shadows.
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> —A. S. EDDINGTON in *The Nature of the Physical World*